Electromagnetic Launcher to Mars

C. Blomberg, Z. Zulkefli, S. Rich, C. Fisk, A. Perez, T. Hale and S. Howe

Center for Space Nuclear Research, Idaho National Laboratory

995 University Boulevard, Idaho Falls, ID

Email: Cheryl.Blomberg@colorado.edu Fax: 303-492-4990

Continuous human exploration of Mars requires the ability to build and sustain a Martian base through frequent cargo launches. Current space launch technologies are limited to rockets which become wasteful, especially in terms of the structural and propellant masses, as the number of launches increases. To reduce the structural and propellant masses associated with frequent rocket missions to Mars, an alternative launch method needs to be considered. Though numerous electromagnetic launchers have been proposed, all of these methods have focused on Earth based launchers. Earth based launchers however are constrained by the significant air resistance and higher escape velocity encountered during launch.

One option to avoid the limitations of an Earth based electromagnetic launcher is to place the launcher on the lunar surface. This proposal investigates the feasibility of using a lunar based electromagnetic lunar launcher for frequent cargo launches from Low Earth Orbit (LEO) to Mars orbit. Different electromagnetic launcher designs were considered and consist of a Maglev launcher design, a linear synchronous motor launcher design and an electromagnetic coil launcher design. Conceptual designs of these electromagnetic launchers were developed and compared to an equivalent Nuclear Thermal Rocket mission to Mars. It was determined that the most feasible launcher design option for frequent Earth to Mars cargo launches is the electromagnetic coil launcher design. This launcher design was calculated to have a 12.7% less ship mass than the next best design option and 17 NTR equivalent launches.